Advanced Cockpit for Reduction of Stress and Workload
The ACROSS consortium consists of 34 partners from 12 different countries within Europe, coming from both the public and private sector. The leading large industrial companies in this field are amongst the partners, together with selected innovative small to medium enterprises, universities and national research centres.

COORDINATOR: THALES AVIONICS (FR)

PARTNERS: AIRBUS (FR), AIRBUS OPERATIONS (FR-UK-DE), BAE SYSTEMS (UK), BOEING (ES), CERTIFLYER (NL), CONTINENTAL (FR), DASSAULT AVIATION (FR), DEEP BLUE (IT), DLR (DE), AIRBUS GROUP INNOVATIONS (FR-DE), GMVIS SKYSOFT (PT), GTD SISTEMAS DE INFORMACIÓN (ES), HELLENIC AEROSPACE INDUSTRY (GR), ISDEFE (ES), JEPPESEN (DE), NLR (NL), SELEX GALILEO (IT), STIRLING DYNAMICS (UK), TECHNICAL UNIVERSITY OF DELFT (NL), TECHNISCHE UNIVERSITÄT BRAUNSCHWEIG (DE), THALES NEDERLAND (NL), THALES TRAINING AND SIMULATION (FR), TONY HENLEY CONSULTING (UK), TRIAGNOSYS (DE), TRINITY COLLEGE DUBLIN (IE), TURKISH AEROSPACE INDUSTRY (TR), UNIVERSITY OF MALTA (MT), USE2ACES (NL), WARSAW UNIVERSITY OF TECHNOLOGY (PL), ZODIAC AEROSPACE (FR).
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ACROSS studies the impact of new technologies and novel interaction solutions to develop cockpit architectures that provide maximum benefits to the crew. These solutions aim to improve safety and reduce accident risk through the reduction of workload and stress.

**OBJECTIVES**

**ENABLERS**

- Crew monitoring
- Advanced Displays
- Advanced Controls and Interaction
- Automation and Assistance
- Aeronautical information and mission management
- Emergency Aircraft Control System
ACROSS aims at providing:

- A set of technology solutions for crew monitoring.
- A set of new avionics functions, providing a demonstrated global performance improvement specifically during peak workload situations, for each crew task (Aviate, Navigate, Communicate and Manage).
- Human Factors based recommendations for management of reduced crew operations, training aspects and future evolution of the functions developed.
- A further progress in the technical capability for continued safe flight and landing in case of crew incapacitation.

ACROSS also defines short-term solutions with short implementation time for immediate use in the cockpit, in order to better support current crews during situations of high stress.
Aim:
Deliver a crew centric approach that addresses the complexity of the relationship between task demand and operator capacity in effectively managing workload.

Methodology:
Develop an integrated concept that links the functionality of HMI to the overall management of the operation, including:
- task performance of the crew;
- the role of automation;
- systemic dependencies.
This concept informs the design and validation of innovative solutions in ACROSS.

Process:
Integrated HF teams support the technology development and validation, applying the crew centred approach to identify HF issues, selecting and implementing HF assessment methodologies, and consolidating HF results, both locally and globally.
Aim:
Ensure that new concepts proposed can comply with regulations.
Identify and mitigate potential safety hazards early in the design process to avoid big design iterations.
Perform a Functional Hazard Assessment (FHA) along with human error analysis.

Compliance with Regulations:
The current regulations applicable to the new cockpit solutions and operational concepts were assessed and potential required changes identified.

REGULATION, CERTIFICATION & SAFETY

Aircraft Level FHA: Safety objectives at aircraft level
System Level FHA: Safety objectives at system level
PSSA Compliance with safety objectives

VALIDATION & GLOBAL ASSESSMENT

Aim:
Guide, support and integrate all the validation activities, to improve project outcomes and provide evidence of results.

Validation objectives:
Assess the impact of the proposed technological solutions for managing peak workload, intentionally and unintentionally reduced crew and full incapacitation on human performance, safety and transitional factors.

 Validation methodology and process:
Based on the European Operational Concept Validation Methodology (E-OCVM) and structured in 3 steps: Initial, Intermediate and Final Validation.

ACROSS MATURITY EVOLUTION

Initial Validation
JAN 2013 - SEP 2013
• Focus on: initial solutions developed
• Validation exercises for the single technologies

Intermediate Validation
OCT 2013 - DEC 2015
• Focus on: validation strategy and objective definition, reference scenarios and initial requirements.
• Validation carried out at project level.

Final Validation
JUN 2015 - JUN 2016
• Focus on: final products and integration of some solutions in the virtual cockpit environment.
• Final validation exercises and results integration
The structure of the project identifies 6 main pillars: 4 pillars focus on the crew tasks which could be impacted by an increment of stress and workload in all the phases of the flight. They correspond to the 4 main functions:

- **Aviate**
- **Navigate**
- **Communicate**
- **Manage systems**

The remaining 2 pillars focus on technologies which can help monitor the crew’s workload at any time, as well as temporarily performing essential crew tasks, and in the most extreme cases, replacing the crew: Crew monitoring and Incapacitated crew. More than 25 technologies and applications prototypes have been developed. The following pages show some examples of the ACROSS innovations. For each category, or function, just one innovation was selected and illustrated in details.
**THE HEAD UP DISPLAY**

is a device that overlays information on the user's normal field of view. The overlayed information through the new Head Up Display symbology can support the pilot during take-off and initial climb, allowing manually flown simultaneous straight-out independent departures, particularly in high density traffic at parallel runways. This functionality helps the pilot to better distribute his attention between the outside of the cockpit and the main information he needs in those phases of the flight, ultimately being able to better manage his workload.

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**OBJECTIVES**
- Improve situation awareness.
- Better understand some automatic modes.
- Ease the use of particular flight operations.
- Better manage workload.
- Provide a degree of automatic response to unplanned (upset) events.
THE WEATHER AWARENESS SYSTEM

presents weather forecasts to the crew: potential thunderstorm, clear air turbulence and volcanic ash threats are highlighted along the aircraft flight plan. The system also proposes alternative routes to avoid them, showing time and fuel impacts. The system supports the crew in anticipating and avoiding threats, reducing stress and workload.

OBJECTIVES

- Increase situation awareness.
- Better support anticipation.
- Simplify access to information.
- Improve support in decision making process.
- Provide better support under difficult and degraded circumstances.
  (e.g. adverse weather, time pressure, degradation of systems, etc.)

NAVIGATE AND MANAGE MISSION

Weather awareness system
OBJECTIVES

- Provide robust and secure data exchanges with existing link technology for high-critically communications.
- Automated operation of Communication systems on the flight-deck.
- Improved communication is an enabler for new procedure in Aviate, Navigate, Manage Systems, remote monitoring/control, and other concepts yet to be defined.

THE FUTURE RADIO MANAGEMENT PANEL provides situational awareness to the cockpit crew regarding the communication system status including current and expected future changes in the ATM procedures, communication link availability, and also voice frequency changes.
OBJECTIVES
- Ease normal system management.
- Partially absorb peak workload in abnormal system management.
- Improve situational awareness by providing more meaningful context.

THE MINIMIZED OVERHEAD PANEL
and the Touch Interface Control Panel support the transition from classical systems management to functions management, thus reducing workload. All concepts are developed as virtual prototypes and tested in the Airbus Group Innovations Virtual Reality Flight Simulator.
OBJECTIVES
The Crew Monitoring System contributes to increasing overall flight safety:
- Improves situational awareness by providing crew with insight into their mental capacities in real time.
- Enables crew initiated and system initiated support for vigilance and workload mitigation strategies.

THE CREW MONITORING SYSTEM
uses different types of sensors to monitor in real time signs of possible pilot impairments such as hypoxia, drowsiness or excessive workload. This information is provided to the crew and the system to support technological and non technological mitigation solutions.
THE ELECTRONIC STANDBY PILOT can take over control and safely bring the aircraft to a landing at the nearest suitable airport. A ground station provides strategic support. The system is to be used to mitigate the adverse effects of total crew incapacitation.

OBJECTIVES
- Allow recovery of the A/C when both pilots become incapacitated.
- Guide the aircraft to the nearest suitable airport and land automatically, performing the conventional automated functions as well as the manual functions of a pilot today.
The ACROSS innovations are expected to work together, reducing the demand in high workload situations and enhancing crew's ability to plan and equitably distribute the effort along the whole trajectory of the operation. The map aside roughly illustrates how the ACROSS solutions are expected to be collocated within a future cockpit concept.

During the last year of the project, ACROSS will focus on the integration of some of the developed solutions in the Airbus Group Innovations virtual environment. Taking into account initial learning about evaluations done on workload reduction and reduced crew operations, ACROSS will identify the main aspects to consider for future implementation of single-pilot operations.
ACROSS CONSORTIUM